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"The most valuable gift which the Hand of Science has ever yet offered to the Artisan." *Dr. Birkbeck.*

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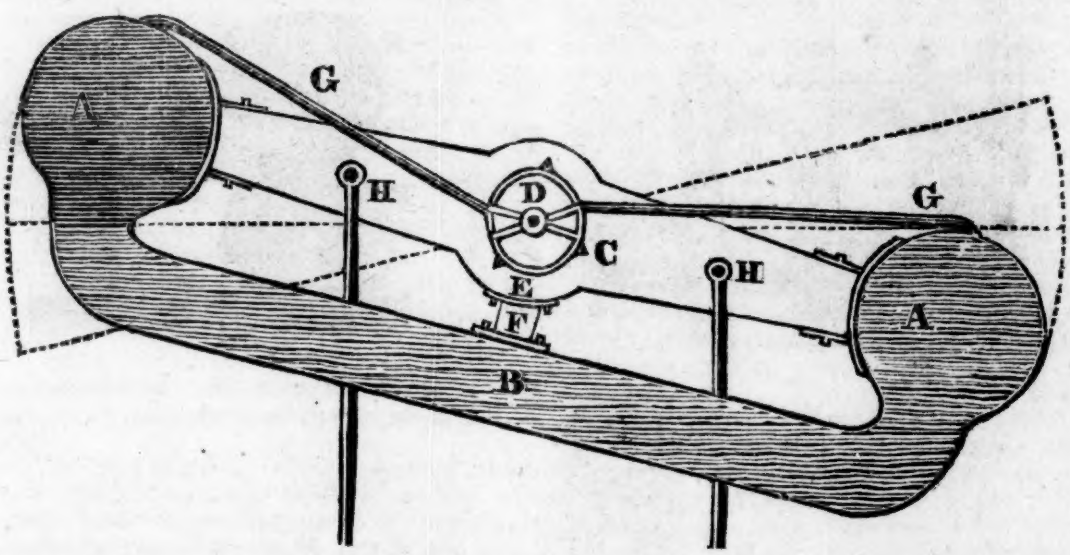
Plan and description of a cheap Steam Engine, for propelling pumps, or any kind of machinery, not requiring uniform motion.— By E. Clark.

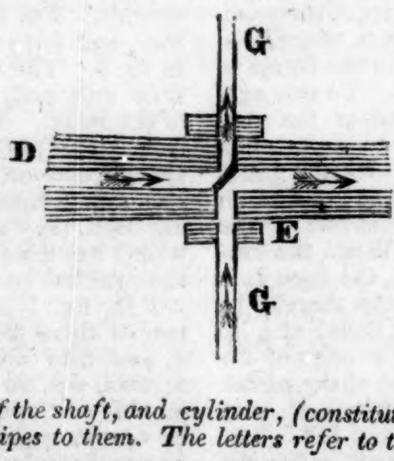
Fig. 1.



AA represents two spherical vessels; B, a pipe allowing of a free communication between them; C, lever beam; D, a cylindrical shaft, which is stationary, and ground to fit into the short cylinder E, so as to form a four-way valve; F, a brace; GG, alternate induction and eduction steam pipes; HH, pump rods.

Note.—In the annexed figure, the steam pipe should have connected with the valve, at the aperture opposite to C.

Fig. 2.



Longitudinal sectional view of the shaft, and cylinder, (constituting the valve;) showing the adaptation of the steam pipes to them. The letters refer to the parts as above described.

If steam of sufficient density be admitted into the vessel, represented as filled with a liquid, it will press this liquid into the superior vessel, causing it to descend; and this motion will reverse the action of the steam, and allow it to operate in the opposite vessel, expelling the liquor from it, and causing it to ascend; while the steam that has been thus expelled, will escape through the pipes, which alternately serve for conveying the steam to and from these vessels.

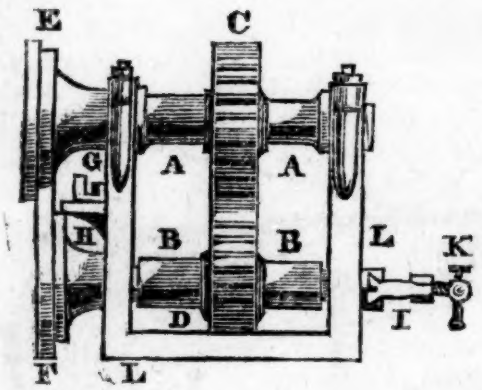
In this manner a vebratory motion may be maintained, sufficiently uniform for pumping water, and propelling some kinds of machinery. Where the engines are of considerable power, it may be found necessary to arrest the momentum of the descending vessel, at a given point, by an elastic medium;—such, for instance, as might be obtained by allowing the vessel to strike on the cushioned head of a gasometrical apparatus; but it is believed that the steam may be so admitted as to render this or any other contrivance unnecessary.

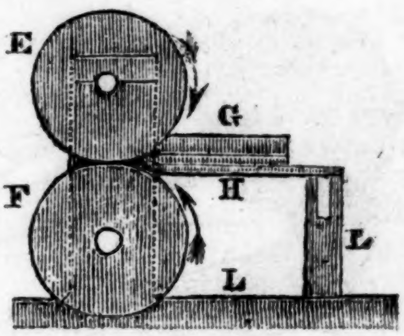
In this application the steam is an indirect agent; while the oil, mercury, and other liquids contained in the vessels and pipe, operating by gravity, becomes the direct one.

The supporting frame work in the above plan has been omitted, with a view more clearly to illustrate the construction of the engine.

PROCESS OF COINING AT THE ROYAL MINT.

(Continued from our last Number.)





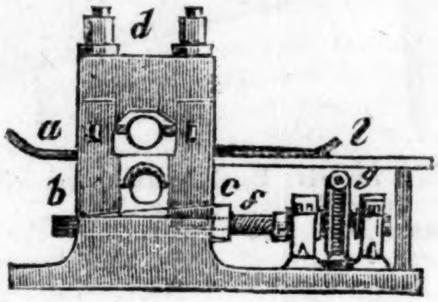


Fig. 2 of the Engraving prefixed to our last Number represents that part of the pouring machine in which the pot is placed: *m* is an axis, which is mounted in the frame of fig. 1 by the pivots at its ends. To this axis is fixed a cradle, which receives the pot. The cradle is joined together so as to open and shut, and the screw *m* draws the parts together until they will fit. The pot L is an arched rack, forming a continuation of the principal bars of the cradle. When the cradle is in its place, as in fig. 1, the rack L is engaged by a pinion K, and can thereby be elevated so as to pour out the metal at a lip or spout, which is made at the edge of the pot for the purpose. The axis of the pinion K is turned by means of the winch D, with a train of wheels, D E, F G, and K I. The man who turns this winch stands before the pot, so as to see what he is doing. The frame of the pouring machine is sufficiently evident from the figure. It is so made as to leave an open space beneath for the carriage containing the ingot moulds.

Fig. 4 is a separate view of a pair of ingot moulds. The two parts, R and S, put together, and form a complete mould, as shown in fig. 5. The upper edge of the mouth is a little enlarged, to facilitate the the pouring of the metal. The moulds are made of cast iron. The part R has the bottom and one side formed on it, and the other half, S, has one side formed on it. Before the moulds are used, they are heated in an iron closet, which has flues surrounding it, and they are then rubbed on the inside with linseed oil.

P Q, fig. 1, is the carriage into which a row of these moulds is placed, as shown at 4, and they are screwed up close by two screws, *p p*, so as to hold them tight; the moulds rest upon a plate which is suspended by screws *q*, at each end, and can by that means be raised or lowered to suit different heights of moulds. The carriage is supported on four wheels, Q Q, which runs upon a rail-way. P P is a rack fixed to the bottom plate of the carriage; in this rack a cog-wheel, N, acts; the cog-wheel is turned by a

pinion, which has a handle, O, fixed upon it; by turning the handle the carriage is moved along the rail-way; and any one of the moulds, 4, can be brought under the spout of the pot, 2; then, by turning the handle D, the pot can be inclined so as to pour the metal into the mould until it is full.

In the silver melting-house there are eight melting furnaces, two cranes, and two pouring machines. Each crane stands in the centre of four furnaces, freely commanding the centre of each, and conveys the pots to the pouring machine. The eight furnaces are worked three times daily, and each pot contains, upon an average, 420lbs. Troy, making the total melting 10,080lbs. There are four men to each four furnaces; each party pour their own pots, and the whole meltings are finished, from the time of first charging in the morning, in little more than ten hours.

The whole of the silver meltings are conducted under the superintendance of the surveyor of the meltings; and he allows no silver to be delivered to the company of moneyers by the melter, unless he has a written order from the King's Assayer Master, authorising such delivery.

The meltings are performed by contract with the Master of the Mint and his first clerk, as melter. He is responsible to the Master for all the bullion he receives, and delivers weight for weight, which renders his situation one of considerable risk and great responsibility. He also finds security for the due performance of the duties of his office.

The bars of silver, of the approved standard. are delivered over to the moneyers, who perform the various processes of the coinage under contract with the Master of the Mint, always delivering weight for weight. They also give security for the due performance of the duties of their office.

Referring to the account of the operation of Rolling, given in p. 233, vol. I., of the *London Mechanics' Magazine*, we now proceed to describe the machine by which the plates of metal from the rolling mill are cut into slips of a convenient width for cutting out the circular pieces or blanks which are to form the coin. This width is generally that of two crowns, two half-crowns, and shillings.

The first and second of the figures given with this Number are representations of this machine. LL is a strong iron frame, which is screwed down to the ground sills of the mill, so that the cog-wheel D will be immediately over the shaft which turns the rolling-mill, and can be turned by a cog-wheel upon that shaft. The cog-wheel D is fixed upon an horizontal axis BB, which is supported in the frame LL. AA is a similar axis placed at the top of the frame, and turned round by a cog-wheel C, which engages with the wheel D. On the extreme end of each axis, A and B, a wheel or circular cutter, E and F, is fixed. The edges of these cutters lie in close contact laterally, and overlap each other a little. The edges of the cutters are made of steel hardened, and they are turned very truly circular, and the edges which overlap are made very true and square. Whilst they are turning round, if the edge of any piece of metal be presented to them, it will be cut or divided just in the same manner as a pair of shears. H is a narrow shelf, upon which the plate is supported when it is pushed forwards to be cut, and G is a guide fixed upon the shelf: the edge of the plate of metal is applied against this guide, whilst it is moved forward to the cutters. The guide is moveable, and the distance which it stands back from the cutting edges, or line of contact of the two cutters E F, determines the breadth of the slip of metal which will be cut off.

To give these slips of metal the exact thickness which is requisite before they are cut up into blocks, they are subjected to a more delicate rolling; or they are drawn between dies by a machine, invented by Mr. Barton, the present comptroller of the Mint.

The third figure given in our present Number represents the finishing rollers, viewed at the end of the frame, in order to show the manner of adjusting them; for it is only in those parts that they differ from the great rollers: *a* is one of the pivots or centres of the upper roller; it is accurately fitted in a collar of brasses, which collar is held down in a cell at the top of the standard by a cap *d*, with two bolts and nuts. These are not intended for the adjustment of the rollers, as in the former instance; but the lower roller is moved for this purpose. The pivot *b* of the lower roller is received in a brass bearing, which is moveable in the opening in the standard-frame. The brass rests upon a wedge *e*, which is fitted in a cross mortice through the standard. By forcing the brass farther in the wedge of the lower roller, it will be moved nearer to the upper roller. The standard at the other end of the rollers is made in the same manner, and the wedges of both must be moved at the same time. To give them motion, a screw, *f*, is fitted into each wedge, and upon these screws are worm wheels, *g*, which are both moved by worms cut upon an horizontal axis, that extends across from one end of the frame to the other, and has a handle at the end to turn it round by, and move the screws and wedges both in equal quantity; *l* is the table on which the metal is laid to present it to the rollers.

RUTHVEN'S ECCENTRIC WHEEL.

A new application of the principle of the Inclined Plane has been invented by a Mr. Ruthven, of Edinburgh, which promises, at first sight, to be of very extensive utility in the arts.

Let the reader conceive an iron pinion, driven by a winch, and revolving vertically, and a wheel of the same metal, in the same position, with its rim resting on the pinion, and revolving by means of the contact or friction of the surfaces. In this position they exactly resemble the wheel and pinion of a common crane, except that they have no teeth. Suppose the wheel to have its axis

placed, not in the true centre, but a little on one side of it, so that the radii (or spokes) of the one side are an inch shorter than those of the other; it is plain, that if we begin where the shortest radii are in contact with the pinion, and make the wheel revolve half way round, the longest radii will then take the place of the shortest, and the axis of the wheel will be pushed or protruded one inch farther than it was from the axis of the pinion. It is this protrusion by the motion of an eccentric wheel that constitutes the mechanical power of Mr. Ruthven's machine. The axis of the pinion turns in a fixed box or gudgeon, while the axis of the wheel is allowed to move up and down, within a longitudinal aperture; and by means of iron rods or pillars resting on the latter axis, the pressure is transferred to a platform in the upper part of the frame, and may be there applied to any purpose.

Mr. Ruthven varies the form of the wheel according to the object he has in view. In some cases it is elliptical, in some spiral, in others it has a heart shape, and in others he employs, not an entire wheel, but a sector embracing 50 or 60 degrees; and though the motion of the pinion is communicated to the wheel by the contact of their surfaces merely, yet where the eccentricity is great, he adds teeth for security.

The mechanician will easily discover, that the power in this machine is essentially that of the inclined plane. If, from the axis of the eccentric wheel, we describe a circle touching the circumference on the inside at the shortest radius, it is evident that the crescent which lies between this circle and the exterior circumference may be considered as a wedge, which, in the course of the revolution, is intruded between the two moving bodies, and forced the one to recede from the other. Now the superiority of this modification of the inclined plane over those in common use, seem to be chiefly these:—1. The principal portion of the friction is that of *rolling*, which, in the case of metal on metal, is probably not the twentieth part of the friction of *sliding*. The portion of the friction consisting of *sliding* is that of an axle within its gudgeon, which of all kinds of sliding friction is the smallest. 2. As compared with the screw (and we may add, the hydraulic press,) it has this grand advantage, that the power admits of every degree of graduation, while that of the former is perfectly uniform. Suppose, for instance, we work with a screw to compress cotton into small hard packages for exportation; then, since the resistance increases in a very high ratio as the compression proceeds, we may begin with one man, but we shall ultimately need to employ ten, because the power of the screw is no greater in the last stage than in the first; but, with Mr. Ruthven's machine, we accomplish that by the graduation of the power, which in the other case can only be effected by an increased application of human strength. By varying the curvature of the wheel, we can multiply the power so that the same application of human force, which produces a pressure of two tons in the first stage, shall produce one of a hundred tons in the last. 3. This accumulation of power, which is of inestimable importance in many cases, is sometimes effected by a combination of levers. But over such combinations, Mr. Ruthven's eccentric wheel has these advantages: first, that the mechanism employed is decidedly simpler, and the friction undoubtedly much less; secondly, that the elasticity, which often defeats the efficacy of combined levers, is completely obviated; thirdly, that we can vary the degree and measure of gradation in any way, with much greater facility; fourthly, the machine can be so formed that its motion shall be constant and progressive, without stops or backward movements, as is the case of levers. Indeed, the inventor thinks, that scarcely any task can be proposed to him which he is not able to perform. He is preparing an engine at this moment for punching, by mere pressure, holes of an inch square through bars of cold iron, five-eights of an inch in thickness, by the strength of a single man.

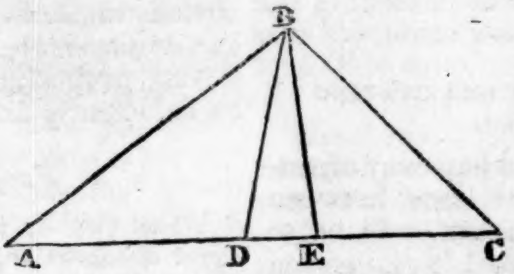
With regard to the power of this machine, it is estimated thus:—

Supposing a man, who pulls with a force of 30 pounds, to turn a winch of 15 inches radius, on the axis of which is a pinion of two inches in diameter, operating on a spiral wheel six feet round, and of half an inch of eccentricity (which gives an inch of protrusion;) then the effect will be as follows:— $30 \times 15 \times 72 = 32{,}400$; that is, supposing the eccentricity to be perfectly uniform, a constant pressure would be produced equal to 15 tons, or a body 15 tons in weight would be lifted one inch: but by making the eccentricity vary at different portions of the circumference, the pressure may be made ten times as great as here supposed at a particular point. It is scarcely necessary to add, that in this case it operates only through a tenth part of the space.

GEOMETRICAL EXERCISE.

The introduction of Geometrical Exercises into your excellent Journal will have a greater tendency to excite a thirst among my brother tradesmen for philosophical instruction, than any other scheme you could possibly devise, and particularly so if they are treated in a form suited to the capacity of those for whom they are intended. Although the generality of mechanics are displeased with the sight of a geometrical theorem (from experience I know this to be true,) yet, if moderately persisted in, the plan will ultimately prove successful, for truth is mighty, and must prevail; and however rude and savage men may be, yet they are always open to reason and common

sense, if left to think for themselves. Certainly no study can be better calculated than geometry for awakening the dormant qualities of the mind, and *forcing* them into action. I send you herewith another Exercise, which you may, perhaps, think worthy of a place in the "Mechanics' Magazine."



Let A B C be any angle; bisect it by the straight line B D, and from the vertex B let fall the perpendicular B E. It is required to prove, that 2 D B E=A C B − B A C—that is, twice the magnitude of the angle DBE is equal to the difference of the angles A C B, B A C.

Another grand object which will be attained by exercises of this nature is, that it will enable the mechanic to read philosophical books with greater ease and pleasure, by giving him a distant notion of algebraic equations; and if you insert them, they will be read—if read, they will be understood—and if understood, I presume you have arrived at the *summum bonum* of your good wishes towards mechanics.

I am, Sir,
Your obedient servent,
JAMES YULE.
63½, Red Lion-street, Clerkenwell,
Sept. 25, 1824.

EXPANSION OF WATER IN FREEZING.

SIR,—Your Correspondent, who calls himself "Gelidus," in your 6th Number, appears not to understand exactly the particular part of the law of the expansion and contraction of water, to which, in the article copied from *The Chemist*, the term "miracle" is applied. This is not the circumstance of *ice* occupying more space than *water*, for many other substances as well as water expand on crystallizing or changing from a liquid to a solid; but long before water begins to crystallize, it expands in cooling. Iron, mercury, and the other substances with which water may be surrounded, continue, after sinking to the fortieth degree, to contract, as the cold increases, while it *alone* begins at eight thermometrical degrees, *before* it chrystallizes, gradually to expand as it cools. It is obviously this fact, not the change of bulk in the act of freezing, to which the Editor of *The Chemist* applies the term *miracle;* and when all its beneficial consequences on the economy of nature are contemplated, though I cannot at present stop to enumerate them, it well deserves, not the *name* of a miracle, perhaps, for it is a *constant* result, but to excite our admiration and wonder. If your Correspondent, Sir, had read the "Mechanics' Magazine" with as much attention as I have, he would have recollected that Mr. Leslie's experiments on producing artificial cold are recorded in its pages. In these experiments the water freezes in the most complete vacuum we can create, and the more complete the vacuum the more speedy the congelation. I, therefore, beg leave to doubt that water absorbs air in freezing, and must still think that even the alteration of bulk which takes place when some bodies change from liquids to solids, is not explained by your Correspondent's gratuitous assertion of "the *admixture of air*." But although the general phenomena of *crystallization* were more happily explained than at present, the gradual expansion of water by cold, after it is cooled down to the fortieth degree, would still remain an *exception* to the general fact

of all bodies contracting as they cool, to which even water itself, when above the fortieth degree, conforms.

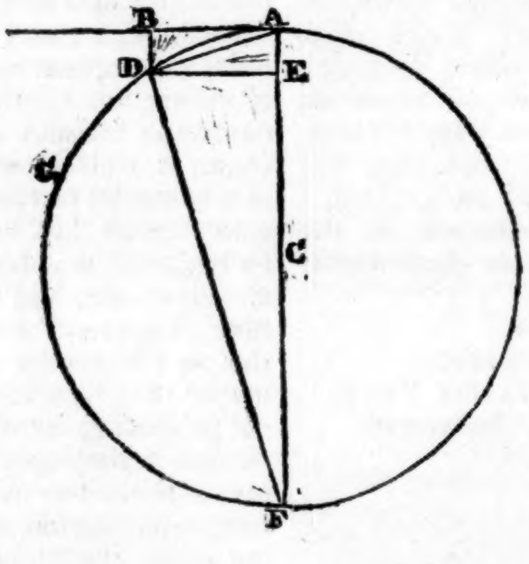
I am, Sir,
Your most obedient servant,
T. H.

PROJECTILE AND GRAVITATING FORCES.

Sir,—Perhaps the best way of settling the question at issue between Majertingun and myself, will be to give the mathematical investigation of the folllowing proposition, though I do not think myself bound by what he has advanced to do so, as his reply is any thing but the application of mathematical calculation to the phenomena of Nature; and I beg leave to observe, that though your Correspondent alludes to the analytical investigation by means of the fluxional calculus, it is my decided opinion, that when a problem can be resolved without such aid it is much better, as it is unnecessary to explain that by principles difficult to be understood which admits of a solution by more obvious methods; and I think, if we can demonstrate the truth of the following proposition, Majertingun will be sufficiently answered.

Proposition.

When two or more bodies revolve at *equal* distances from the centre of their orbits, but with *unequal* velocities, the central forces, (that is, the gravitating forces) necessary to retain them in their orbits will be to each other as the *squares* of their *velocities*, that is, if one body revolve *twice* as fast as the other, it will require *four* times the retaining force the other does, if with *three* times the velocity it will require *nine* times the retaining force to make them describe equal orbits.



Demonstration.

Let A D F represent a circle whose centre is C, and let A B be a tangent to the point A; now, let there be a body impelled by any force from A in the direction A B; let there be a force acting from the centre C on the body at A, which will tend to draw the body from A to C; and suppose these combined forces are such as to cause the body at A to revolve in the circumference of the circle A D F.

We will now estimate the force exerted to produce the deviation from a right line to a circular one. Let us conceive the point D very near A, and through D draw F D; then we may, as the points D and A are nigher to each other than any finite magnitude, consider the arc A D and the chord A D to coincide for an inconceivable small distance, and we may use the chord A D or the arc A D in our calculation as the same line; then A B will represent the projectile force, and A E the gravitating force, and the body will describe the arc A D by their united efforts; and as A E is the gravitating force or space the body has moved by virtue of the central force, it will be always proportional to the force itself. The value of that line or A E is now to be ascertained. Join the points D and F; then (by 31st of Euclid III.) the triangle A D F is right-angled at D, and, consequently (by the 8th and 6th of Eu-

Euclid VI.,) $AE : AD :: AD : AF$; hence $AE = \frac{AD^2}{AF}$: and as the arc AD and the chord AD are supposed equal to each other, we have $AE = \frac{\text{arc } AD^2}{AF}$, which is a correct expression, denoting the force of gravity necessary to retain a revolving body in a circle. Now, as the *space* a body would move in by the force of gravity is as the *square* of the *time* that action contiunes, let there be any other point, as G, in the circumference given, if we make $AD = t$, $AG = T$, and S the *space* the body would move in the time t, we shall have $t^2 : \frac{AD^2}{AF} :: T^2 : S$; then, as the motion of a body in a circle is uniform, we shall have $t : T :: AD : AG$; square this proportion, and we have $t^2 : T^2 :: AD^2 : AG^2$, or, altering the position of the first proportion, we have $t^2 : T^2 :: \frac{AD^2}{AF} : S$. Now, comparing these two together, we have $AD^2 : AG^2 :: \frac{AD^2}{AF} : S$, which, turned into an equation, will be $S \times AD^2 = \frac{AD^2 \times AG^2}{AF}$, that is, $S = \frac{AG^2}{AF}$; that is, the space along which a body revolves in a circle is always equal to the *square* of the gravitating force divided by the diameter of the circle in which the body revolves. Hence it follows, that the central forces necessary to retain the circumference of a circle must be such as, if we suppose the projectile motion to cease, would cause the body to move towards the centre of the circle over a space or distance equal to the *square* of the arc of the circle described, divided hy the diameter of the circle, and, consequently, in every case, will be proportional to the square of the arc the body would describe in a given time, divided by the diameter of the circle; and hence the *enegergy* of the central force is proportional to the *square* of the arc the body described in a given time, divided by the diameter of the circle. Now, if the velocity in the point A will carry the body to D in v times, it will carry it from A to G in $2v$ times; but, supposing the velocity at the point A to be doubled, it will reach the point G in the same time as it would in the former case reach D. Now, as $v : 2v :: \frac{\text{arc } AD^2}{AF} : \frac{\text{arc } AG^2}{AF}$; that is, $v \times \frac{\text{arc } AD^2}{AF} = 2v \times \frac{\text{arc } AG^2}{AF}$, or $v \times \text{arc } AD^2 = 2v \times \text{arc } AG^2$, or $v : 2v :: AD^2 :: AG^2$; then, supposing the arc AD be assumed as unity, or 1, and the arc AG as twice its value, or 2, then we shall have this proportion, as $v : 2v :: AD^2 = 1 : AG^2 = 4$. Q. E. D.

The same kind of demonstration would have shown, that when the body revolves in any orbit, as the ellipse, parabola, &c., the same law holds good; but the calculation would have embraced some properties of the conic sections, which would have lengthened the calculation unnecessarily, and perhaps perplexed the general reader. I thought the investigation, as regards circular orbits, would be quite sufficient, and also because Majertingun seems to found his objections respecting them in particular; and shall here only add, that had we given the solution respecting other orbits, we should have had to consider the property of revolving bodies from that of their describing equal areas in equal times, instead of that of describing equal parts of the circumference in equal times.

Having now, I think, satisfactorily proved the proposition, I have only to thank Majertingun for his *valuable* reference respecting what Benjamin Martin says on the subject; and also that when he comes to the conclusion, that the *fluxion* of the projectile force infinitely exceeds the *fluxion* of the central force, he does not mean to assert that the central force is, in fact, nothing, or of no effect; for, if he did, it would be the same thing as asserting, that the projectile force is of *itself* sufficient to cause a body to revolve in a circular orbit, which is not even maintained by the Major himself.

I shall conclude this paper with what I conceive to be the meaning of the fluxional expression, $\frac{\dot{z}^2}{d} = \dot{x}$, referred to in Martin's Mathematical Institutions, page 73, vol. II. which is simply that the versed sine of an infinitely small arc is, in comparison of the radius, as a mathematical point is in comparison to any finite line, or

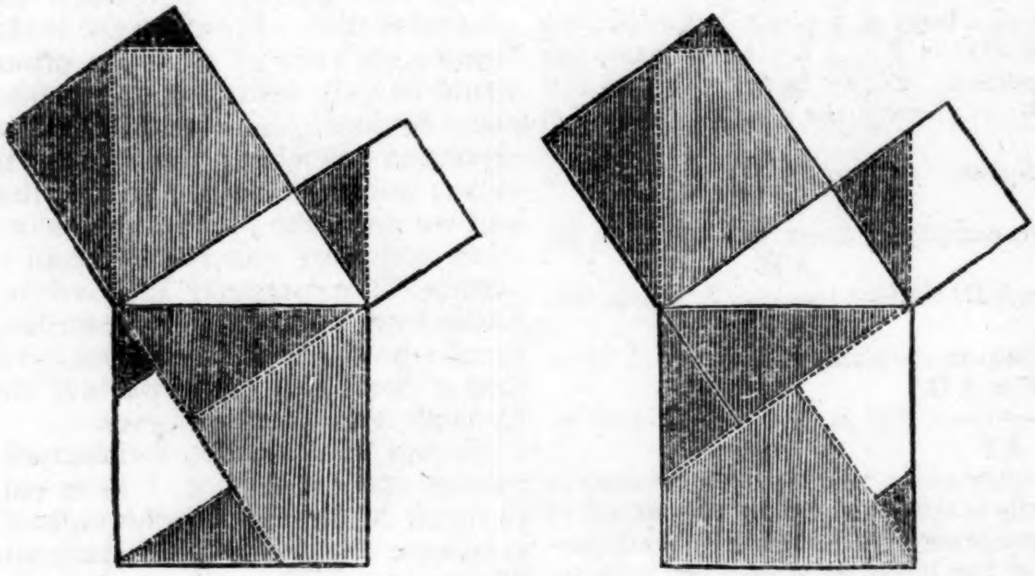
as a fluxion is in comparison to a flowing quantity; for, as a point, which is of itself of no finite magnitude, may be conceived by its motion to generate a line, so may the combined efforts of the projectile and gravitating forces cause a body to revolve in the circumference of a circle, though the proportion they bear to each other may be less than any finite magnitude.

As to the calculations Majertingun wishes me to make, as they cannot tend to elucidate the subject, or answer any useful *practical* purpose, it would be only filling your useful pages, to the exclusion of what I have always thought and still believe to be of more benefit to mankind—the improvement of the mechanical arts; for it has always been my maxim to employ theory only where practice is likely to be benefitted by its application.

I remain, Sir, &c.

Oct. 25, 1824. G. A. S.

MECHANICAL SOLUTION OF A MATHEMATICAL PROBLEM.



Sir,—Presuming that a mechanical explanation of Euclid's far-famed and generally considered difficult proposition would be acceptable for your pages, I have, after some considerable trouble, formed two diagrams, which are so clear a proof that the two □, formed upon the base and perpendicular of a right-angled triangle, are, together, equal to a □ formed upon the hypothenuse, that I conceive this fact will be as evident to young mathematicians as it already is to the learned. The different shades of colour in the diagram show the parts which correspond with each other; and the whole may be proved correct by drawing the figure, and afterwards cutting it into the several pieces marked, and applying them to each other.

I am, Sir, &c.

Mechanicus.

METROPOLITAN WATER-WORK COMPANY.

Sir,—Observing a project on foot for establishing a Company, to be designated the "Metropolitan Water-work Company;" having for its object the supply of the metropolis with pure and wholesome water, to be obtained from the springs below the blue clay, about 35 fathoms depth, I may be entitled to make a few observations in favour of the project, though entirely unconnected with, and unknown to the projectors, on account of my having made a proposition to the Directors of the Imperial Gas Light Company, when their works were erecting, to the same effect, some two years since.

Being fully convinced, from the peculiar circumstance of water rising to the surface, or nearly so, in borings

of from two to three hundred feet in depth, arising from its being confined below its natural level by an impervious clay, that we could, by being enabled to sink shafts to so great a depth, draw sufficiently below such level to ensure almost any supply; I took a favourable opportunity of suggesting to the Directors of the above Company a plan to that effect, and likewise for the employment of any extra power that might be required, beyond what would have been necessary for such purpose, which was to be effected by forcing water through pipes, and thereby conveying the power of the engines so as to act on, and give motion to, machinery at any distance—I say a favourable opportunity, because the necessary power might have been obtained from their works at little expense; and when they were erecting, it would have been an easy matter to have formed them for the double, or, I might say, the triple purpose.

From the great extent of these works, a number of large engines might be kept at work by placing boilers over the retort furnaces, if properly constructed for that purpose, whereby steam could be produced at little, or perhaps no additional cost of fuel; hence the profit arising would be acquired at merely the expense of a few engine men, turncocks, wear, tear, &c after the works were once completed, which would have enabled the Company to supply pure water at a rate much under any other, and render the concern one of the noblest of the kind ever undertaken.

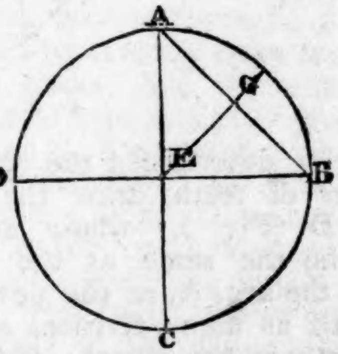
I was not aware, when I made the proposition to the Company, that the late Mr. Walker had entertained the same opinion as regards the supply of water, which, in the advertisement, he is stated to have done, and that he had reported thereon nearly six years ago; nor of the late Mr. Bramah's proposition to force water through pipes in the streets, from whence any person requiring small power might obtain it, until I saw it briefly noticed in a Magazine of this month.

I am, Sir, yours, &c.
WILLIAM GILMAN.

N. B. In finishing the shafts, some little skill, ingenuity, and caution, will be requisite; for it must not be forgotten, that if we sink 200 feet below the natural level of the spring, that the pressure of the water upwards will be equal to 100lbs. per square inch over the whole area; so that the utmost care, to prevent accidents in their completion, and skill, with peculiar apparatus, to extract the whole body of clay left above the porous strata, after it is become unsafe for the workmen to remain below, will be necessary.

MEASURING CIRCUMFERENCES.

SIR,—It may be useful to your readers to know that the circumference of a circle may be found with great practical accuracy with a common pair of compasses by the following easy process:—



Divide the circle (or any given circle) into four equal parts, A B C D; draw a line from A to B; divide the quarter of the circle, A B in half, E F. Now three times A C, and once F G added thereto gives the length of the circle A B C D within the 1-40 0th part of the said circle. A less angle would, of course, give a greater approximation, but would be less easy to the uninformed artisan. In words the fact might be stated thus:—

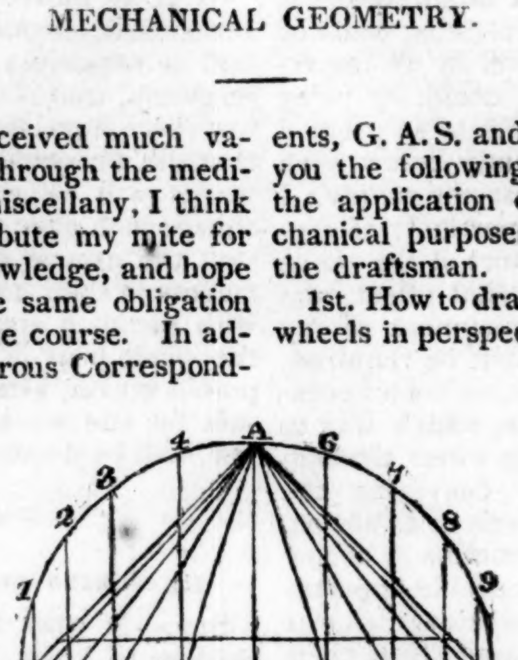
Three times the diameter and once the versed sine of the angle 45° gives the circumference within the 1-4000th part.

I am, Sir,
Your obedient servant,
H. C. JENNINGS.
Devonshire-street, Portland-place,
Oct. 1, 1824.

MECHANICAL GEOMETRY.

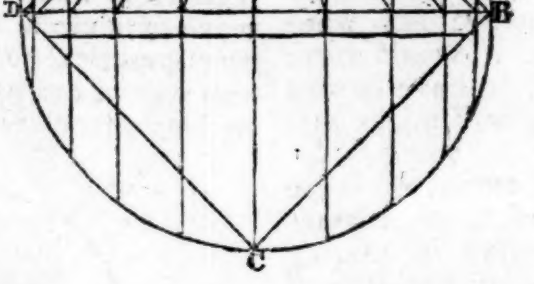
Sir,—Having received much valuable information through the medium of your useful miscellany, I think it my duty to contribute my mite for the increase of knowledge, and hope every one under the same obligation will pursue the same course. In addition to your generous Correspondents, G. A. S. and Massa Jones, I send you the following diagrams, showing the application of Geometry to mechanical purposes, and its utility to the draftsman.

1st. How to draw the teeth of bevil-wheels in perspective.



Having determined the scale and number of teeth, draw the circle, A B C D (Fig. 1,) whose diameter must be the same as the wheel; divide the arc, A, on the periphery, into half as many divisions as there are teeth in the wheel; divide the arc C into the same; then draw the chords, 1, 2, 3, &c. and their intersections with the diameter will show the point of the teeth; diagonals drawn from the intersections to A, which is the apex of a cone of which the wheel is the base, will give you the bevil of the teeth; draw the lines B D to C, and these will shape the back of the teeth.

2d. How to draw a line upon the surface of a cylinder, which shall be exactly parallel to the axis.



Suppose E F G H to be the contour of a cylinder; apply any point to the cylinder, whilst revolving at or near the middle, so as to describe a ring upon the surface, as at I; then set your compasses at any convenient distance, say at K, and make the arc J; then set the joint of your compass at J, and make the arc K; a line drawn through the intersection will be parallel to the axis.

I am, Sir,

Your obedient servant, R.

Manchester, Sept. 7th, 1824.

CHEAP DRUNKENNESS.

Most of your metropolitan readers, Mr. Editor, must have learned from the newspapers, that a Mr. Henry nightly amuses the audience of the Adelphi Theatre, by exhibiting people under the influence of the laughing gas. When we are every day made sensible of the fatherly care the government takes of the people, checking drunkenness, by increasing the tax on ardent spirits; removing all temptations to sin, by putting down dancing-houses, glee-clubs, fairs and private theatricals, and encouraging holiness of life, by building churches and paying parsons; keeping from the unsullied minds of the people all knowledge of evil, by stopping the circulation of books not approved of by the Vice-suppressing and Tract Societies; forbidding them to break their necks, by breaking down stage-coaches with their weight; and providing them with comfortable lodgings in houses of correction, if they are found exposing themselves to the inclemencies of the weather, I, for one, Sir am much surprised that it should permit this exhibition by Mr Henry; and can only account for its negligence, by supposing that it is not so learned in chemistry as it is in morality and theology, and is ignorant that what he calls the *laughing gas* is a fluid, which, at a small expense, produces a most delightful, though transient state of intoxication. The exhibitor, probably, had an eye to concealment when he called it *laughing gas;* had he called it *nitrous oxide*, the President of the Royal Society, who was the first to get excessively tipsy by inhaling this fluid, and the poet-laureat, (Mr. Southey) who, at one period, drank largely of it—though the influence of any rapture-inspiring drink is not very perceptible in his writings, and who has, on several occasions, loudly and energetically sounded the tocsin, when he thought it was necessary to rouse ministers to a more than ordinary degree of vigilance in taking care of the morality of the nation—would have both thought it their duty, *ex-officio*, to warn the government of the numerous ill effects which might result from teaching people to get drunk at a cheap rate. Perhaps, Mr. Editor, you may subject yourself to a prosecution by Mr. Murray, should you insert this communication, for spreading abroad a knowledge of a means to get easily and pleasantly fuddled, which, as all the world knows, is the forerunner of all mischief. At least, I remember an unfortunate man being most severely punished some years ago for this violation of decorum. Our seamen, it is well known, have a very strong propensity to forget all the cares of the world, including a forced absence from wives and families, and flogging in abundance for not liking this; and on board one of the king's ships, the men were perpetually in a state of intoxication. For a long time it was not possible to ascertain how this happened. The purser was closely examined, but he was quite positive that not one of the seamen had received a drop more than his allowance; the hold and the spirit room were carefully inspected, but not a hole was found large enough for a mouse to creep through; consequently no toper could have reached the rum casks; and if the mouth could only be kept shut after grog has been taken in, the secret might not have been discovered till this time, and the nation might have been vanquished, invaded, and destroyed, by a cheap mode of getting drunk. One of those who could neither sit nor stand, (walking was quite out of the question) betrayed the secret. After drinking his grog, he boasted that he placed himself on his head, with his heels in the air, till the liquor took full effect, and he became glorious and oblivious. Standing on the head was immediately put a stop to, and the individual who had discovered this great improvement in the arts, and great saving of labour, having been found out, he received flogging enough to keep him sober at least till he got out of the hospital. If the poor sailors had only known of Sir Humphrey Davy and Mr Southey's mode of committing excesses, they might have enjoyed their elysium unflogged till this time; for the drunkenness which they indulged seldom goes so far as to make a man unfit for muscular exertion. Their mode was to breathe nitrous oxide, or the laughing gas of Mr. Henry. As your readers may wish to learn this mode of

intoxicating themselves, to the ruin of Messrs. Hodges and Barclay, and all the fraternities of distillers and brewers, I shall now communicate this agreeable information.

Let them, then, purchase some of the salt, known to chemists by the name of nitrat of ammonia, (I believe they may tipple for a week for the value of two-pence) put it into a glass retort, and apply to it the flame of an argand lamp. When the temperature reaches 400° of Fahrenheit, a whitish cloud will begin to project itself into the neck of the retort, accompanied by a copious evolution of gas. This gas is nitrous oxide. It should be received into a bladder, from which atmospheric air has been previously, as much as possible, excluded by mechanical means, such as twisting the bladder together, allowing the air to escape; and the bladder should have a pretty wide glass tube affixed to its mouth. A silk bag will answer as well as a bladder, but it is more expensive. A large bladder is however requisite, as it takes a few quarts of the nitrous oxide to produce a full and proper effect, and it must be inspired two or three minutes. Having thus collected the gas, which is of a sweetish taste, possessing all the mechanical properties of air, it may be easily breathed; but care must be taken not to be in a hurry, as the terror people feel sometimes prevents the gas from having its proper effect. If this gas be breathed for two or three minutes, a most agreeable intoxication is produced, which strengthens and invigorates the body as well as the mind, and leaves no lassitude, or blue devils, or headaches, requiring soda-water, behind. But as your readers may not trust me, I shall transcribe for them Sir Humphrey Davy and Mr. Southey's account, the latter being of course by far the most poetical. The former says, "Having previously closed my nostrils and exhausted my lungs, I breathed four quarts of nitrous oxide from and into a silk bag. The first feelings were those of giddiness, but in less than a minute, the respiration being continued, they diminished gradually, and were succeeded by a sensation analagous to gentle pressure on all the muscles, attended by a *highly pleasurable thrilling*, particularly in the chest and extremities. The objects around me became dazzling, and my hearing more acute. Towards the last inspiration the thrilling increased, the sense of muscular power became greater, and at last an irresistible propensity to action was indulged in. I recollect but indistinctly what followed. I know that my motions were various and violent. These effects very soon ceased after respiration.—In ten minutes I had recovered my natural state of mind."

Mr. Southey felt first a fulness and dizziness in the head, such as to induce a fear of falling. This was succeeded by a laugh, which was involuntary, but *highly* pleasurable, accompanied with a peculiar thrilling in the extremities, *a sensation perfectly new and delightful.* For many hours he imaged that his taste and smell were more active, and certainly felt unusually strong and cheerful. In a second experiment he felt pleasure still superior, and once poetically remarked, that he supposed the atmosphere of the highest of all possible heavens to be composed of this gas. Mr Wedgewood, after breathing this gas, threw the bag from him, and kept breathing on laboriously with an open mouth, holding his nose with his left hand, without power to take it away, though aware of the ludicrousness of his situation. All his muscles seemed to be thrown into vibrating motions; he had a violent inclination to make antic gestures seemed lighter than the atmosphere, and as if about to mount.—Before the experiment he was a good deal fatigued by a long ride; but after the experiment every trace of fatigue had vanished. In a second and third experiments, the same effects were perceived, only that the pleasure was in the third much greater than in the two others. Indeed, Sir Hnmphrey Davy, who has fuddled himself pretty often with this gas, declares that it is far better than champagne, as it not only gives a more intense pleasure, but leaves no headach, and does not diminish in its effects from repeated use.

Mr. J. W. Tobin said, his sensations were exquisite, quite indescribable;

and that he felt his strength permanently increased by it. Here then, Sir, is abundant testimony to the superiority of this as an inebriating fluid. The advantages for the public will be as great as for the individuals. There will be no occasion to import French wines or Dutch Gin; the corn which is now consumed to make beer, and the sugar which is converted into rum, may be both employed to nourish an increased number of people; and the world may bid defiance to Mr. Malthu and his gloomy doctrines, as long as it has such resources in store as the tracts of land now every where employed in producing the materials for making strong drink I understand, Sir, if the government shows no inclination to check this manufacture by a heavy stamp duty, (and while the present liberal notions as to freedom of trade prevail in the cabinet this is not expected,) there are to be two manufactories of this gas established in different places. The individuals will not, however, be required to go through the terrific process of applying their mouths to bags or bladders, but will just pass through an elegant room, constructed on the gasometer principle, the doors of which are to be valves I shall not enter farther into details, but only remark, that though signs, as in former times, may be necessary to point out the spots where men may get cheaply drunk, it will not be necessary to add "clean straw provided;" for this is so pleasant a mode of losing one's senses, that a stage may be necessary for the exhibition of the merry-andrew tricks of the inspired; but no sleeping apartments will be requisite.

I am, Sir,

Yours obediently,

ANTI-DRAM.

[*The Chemist*]

INTEREST AND DISCOUNT.

"Interest and discount have been confounded together, and by many considered as one and the same operation. No such analogy will, however, be found between them: interest consists in the addition of so much per cent. to the principal; discount is a reduction of the principal. It is evidently a mistake to suppose that, by adding the interest to a given sum, at a certain percentage, we enable it to sustain the reaction of the same rate per cent. discount, because the discount is not only taken off the principal, but likewise off the sum added to it. For instance, five per cent. added to 100*l.* increases it to 105*l.*; but take five per cent. from 105*l.* there remains only 99*l.* 15*s.*—occasioning a loss of five shillings, or one quarter per cent.

"The proper mode of adding a profit or a discount is as follows:—

Principal - - - - - - - - - - -							£100	0	0
Add five per cent.	on	£100	0	0	-	is	5	0	0
Ditto	on	5	0	0	-	is	0	5	0
Ditto	on	0	0	5	-	is	0	0	3
Ditto	on	0	0	3	-	is	0	0	0¼
							£105	5	3¼

Which sum will allow of five per cent. being taken off, and still leave the original principal, 100*l.*, unimpaired.

"Although the difference in the above example is trivial, yet it becomes more serious in proportion to the increase of the percentage. To cover a discount of 20 per cent., 25 per cent. interest must be added; and to sustain 50 per cent. discount, the principal must actually be doubled."

ON THE CONSTRUCTION OF STEAM VESSELS.

SIR,—As a ship-builder, my attention is, of course, attracted by any thing relating to naval affairs, particularly to the propelling of vessels, whether by wind or otherwise; and I am sorry to observe so much waste of power, whenever steam is applied as the propelling force. I am led to make these remarks from observing, in all the steam vessels I have seen, that the paddle-wheels, instead of getting firm hold of the water, and thereby communicating their entire force, or nearly so, to the vessel, are constructed so narrow, and the floats so close together, as to drive the water aft to such a degree, that it runs under the quarter at the rate of eleven or twelve knots, whilst the real progress of the vessel is but six or seven knots, showing a loss of nearly 50 per cent. This might, in a great degree, be avoided, by making the paddle-wheels of greater breadth, and placing the floats five or six feet apart, instead of three feet, or thereabouts, as is the practice now. The paddle-wheels of a steam vessel ought to be considered as a pinion working in a rack, and the strength of the rack is but in proportion to the cubic contents of the water between the floats; it is therefore evident, that if the space between the floats contain eighteen cubic feet on the present system, and the floats were removed to five feet, the floats would act against a body of water that would offer two-thirds more resistance (supposing the breadth of the wheels to be the same,) and, of course, act on the vessel with two-thirds more power than before, which, of course, would increase the speed of the vessel through the water. It may be objected, that the strokes would be slower, and therefore the vessel would not move any faster. This is a mistaken idea, and is contrary to experience; as persons conversant with nautical affairs well know, that, in rowing, it is not the quickness of the stroke, but the length of it, as it is technically termed, that propels the boat fastest through the water. The form of the vessel is also of great importance, particularly the bow and quarter. The present prevailing mode of giving steam vessels so much rake forward, is, I am convinced, injudicious, particularly for those which go to sea, as it, of necessity, renders it much bluffer, and presents a surface nearly at right angles with the direction of the sea, which, of course, has then its greatest power, and impedes her progress. Another serious disadvantage is, that it has a tendency to drive the water up before it to the height of several inches, which is equal to an increased draught of water of so many inches, besides giving a form to the bow which cannot divide the fluid with so much ease as is experienced in the case of a more upright stern. This will be evident on comparing the sections of the two bows, taken in an angle of 30 or 35 degrees from the keel, which is nearly the direction of the water from the fore-foot to the surface. The form of the quarter is also of great importance both to the steerage and velocity of the vessel. As these vessels have no sails to assist the steerage, the quarter should be fine, so as to give easy steerage, and allow the water to leave, without those eddies so frequently seen under the quarter.

I trust you will pardon my trespassing on your valuable pages to this extent, and hope these remarks will draw the attention of persons more able than myself to the subject, that our practice in ship-builing may be improved, so that our vessels may excel in speed all others,

I am, Sir, yours, &c.

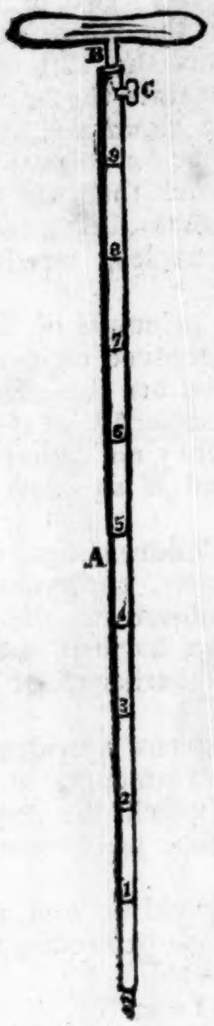
Ipswich. GEORGE BAYLEY.

VELOCITY OF HAMMERING.

SIR,—Many of your readers are in the daily practice of using a *hammer;* perhaps few of them have troubled themselves to ascertain the *velocity* with which they are able to strike any material with the hammer. From experiments made with hammers of various weights, I have found the velocity not to exceed above 60 feet per second; and that a velocity between 15 and 30 feet per second may, without much error, be considered the usual velocity.

B. BEVAN.

EARTH BORER.



SIR,—The Borer, a sketch of which is placed above, has been found useful in ascertaining the nature of the soil for the foundations for masonry, in the formation of quay walls and piers at Bridport Harbour. A is a tube, about ten feet long, formed of old gun-barrels firmly soldered; B, an iron rod, fitted to the tube, and fixed in handles similar to those of an auger, the point of the rod projecting almost two inches below the end of the tube; C, a screw, which, turned by the thumb and finger, keeps the rod in its proper place. The instrument is bored into the loose sand or soil to any depth within its length, which depth is shown by the scale marked on the tube; the screw is then loosened, and the rod withdrawn four or five inches, and again fixed. The instrument is then bored to a farther depth, and tube receives a portion of such stratum as it may have perforated, and the instrument being withdrawn altogether, retains such portion as is forced out for examination by restoring the rod to its original position. I am not aware that this simple invention has the merit of originality; but if it have not, it may, through the medium of your useful publication, become more generally known.

I am, Sir &c.

E. NICHOLETTS.

Bridport, (Eng.) Sept. 20, 1824.

COPPER SHEATHING.

Mr. Children, one of the Editors of the Annals of Philosophy, has given, in the last number of that publication, an article on certain mistatements which have appeared in the Newspapers respecting Sir Humphrey Davy's method of protecting the Copper Sheathing of Ship's Bottoms, and which were partially adopted in our own pages.

Mr. Children had himself said that the defended metal is more liable to become foul from the adhesion of weeds, barnacles, &c. than the undefended; but he now informs us, that more accurate inquiries have convinced him that he should have been more guarded in admitting the fact as a general result, the assertion requiring much qualification to make it consistent with truth. The following Mr. Children states to be the actual result of the experiments which have been made:—

"The two harbour-boats, which gave rise to the original exaggerated account (that vessels had returned after short voyages with their bottoms completely covered with barnacles, weeds, &c. *were purposely pre-defended* by a surface of zinc in the proportion of about 1-25th of that of the copper; the object of these preliminary experiments being solely to ascertain the *efficacy of the plan as a preservative of the copper*, without reference to any ulterior effects. These boats were stationed in Portsmouth Harbour, and the copper remained bright for nearly three months, when it became coated with carbonate of lime, to the rough surface of which the confervæ, always

floating in the summer months in Portsmouth Harbour, adhered; and these soon caught other weeds, but they were all *loose, and there were neither barnacles nor any other shell-fish, nor any worms*, amongst them; and it is more than probable that the same weeds would have adhered even to carbonate of copper."

Mr. Children adds—"Except in harbour there is every reason to think that carbonate of lime could not adhere to the copper, *even with excess of protection*, and the confervæ must have been washed off in a ship at sea. Copper, until it is worn in holes, corrodes so fast, that no permanent surface remains to which weeds can adhere; but when there are inequalities on the surface, they adhere readily enough even to the poisonous oxide of the copper. I do not believe that any of the protectors placed upon ships are in such excess as to occasion any deposite; and if they are a little positive, or nearly in equilibrio, the whole surface remains smooth, and the adhesion of weed and shell-fish is prevented. As far as the experiments hitherto made enable one to judge, the requisite proportion of protecting surface to that of the copper is somewhere between 1-120 and 1-220; but even 1-300th will save more than half the copper of the navy."

A letter from Mr. Barrow, Under Secretary to the Admiralty, is added, corroborative of Mr. Children's statement.

Thus far Mr. Children. But that his defence or explanation is any thing but satisfactory, may be seen from the following letter, which we have received on the subject from Sheerness Dock-yard, and which we deem it due to the cause of truth to insert.

Sir,—In the last Number of the "Annals of Philosophy," there is an article by Mr. Children, the champion of Sir Humphrey Davy, on the subject of Ships' Bottoms, and his trip to Norway. With the former only you have to do. And,

1st. Mr. C.'s account of the "two pre-defended" boats in Portsmouth Harbour, is to be met by this fact, that in this dock-yard six vessels have been "Davied;" two of which, the Gloster and the Howe (the former at anchor since the 12th of July last, and the latter since the 30th of April—both too in a *rapid tide*,) are as foul as it is possible for ships to be; much more so, indeed, than any other vessel in this harbour, being covered with echinæ, barnacles, weeds, worms, muscles, &c.

2nd. This principle of Sir H. Davy's is to preserve copper from decay: but what are the effects resulting from the *attachment* of those animals? Do they not adhere for *subsistence?* and if so must they not *destroy?*

3rd. Mr Children says, that "except in harbour, carbonate of lime could not adhere to the copper." Now this is a harbour *with a tideway*, and yet carbonate of lime does adhere.

4th. Mr. Barrow's evidence on the subject merely amounts to this, that the ships on which the experiments have been made have "not been reported."

I think it would be well in the Admiralty to pause before any more vessels are "Davied."

I am, Sir,
Your obedient servant,
Spyglass.

Sheerness Dock-yard, Nov. 1.

STEAM-PIPE JOINTS.

Sir,—I should feel obliged to any of your intelligent Correspondents to inform me which of the different methods, now in use, they consider the best for putting together the joints of Steam-pipes. I have seen mill-board and white-lead, as also iron-cement, make very good joints for pipes of not more than six or eight inches diameter, but both those methods fail in pipes of one foot diameter, when I have seen what is generally termed, by engineers, a gaskin, that is, long hemp mixed with white-lead, and plaited, applied, which has made a tight joint.

A receipt to make a good iron-cement is much wanted.

I am, Sir,
Your obedient servant,
Henly-on-Thames. J. T.